

MR. C. J. ELMORE reviews¹ the several systems of classification of the diatoms, favoring Petit's as approaching "most nearly to a natural one, because based on characters having a physiological significance," viz., on the structure of the endochrome and the mode of forming auxospores. In higher plants these are unstable characters; are they not likely to be so also in the diatoms?

FOR SOME TIME before his death, Professor D. C. Eaton had been preparing to issue a set of *Sphagna* in collaboration with Mr. Edwin Faxon. That work has now been completed by Mr. Faxon, and a set of 172 specimens, representing 39 species, their varieties and forms, has been issued by Mr. Geo. F. Eaton with the title *Sphagna Boreali-Americana Exsiccata*. Most of the determinations are by Warnstorf, and no pains have been spared to make the set first-class in every particular. Those who already know the beauty of specimens prepared by Mr. Faxon need not be assured that these are fine and abundant. For the credit of American bryology it is only just to say that no previous issue of moss exsiccata anywhere to our knowledge surpasses this one in the abundance and beauty of the specimens or in careful labeling. Sixty sets will be issued at \$15 per set.—C. R. B.

IN HIS ADDRESS upon "grasses," before the Massachusetts Horticultural Society last March, Mr. F. Lamson-Scribner gave a brief account of the uses, form, structure, and distribution of grasses, and then discussed the economic grasses of Massachusetts, concluding with a short statement of the work of the division of agrostology.

As a part of this work we note the recent issue of a bulletin (No. 3) upon useful and ornamental grasses of all countries. In the introduction a number of the most important economic grasses are classified according to their uses, while the body of the bulletin enumerates about 375 species, illustrated by eighty-nine figures, with a short account of their qualities, value, and culture. The compilation is a very useful one.

NOTES FOR STUDENTS.

A LIST of parasitic fungi, occurring in the state of Mississippi, supplementary to the one printed in May 1895 (Miss. bulletin no. 34), has been issued from the Mississippi Experiment Station (Bull. no. 38) by S. M. Tracy and F. S. Earle. It adds 85 species to the former list, of which 21 are new to science. The descriptions of the new species have also been published in the *Bulletin of Torrey Botanical Club* for May of this year. *Cercospora flexuosa* Tracy & Earle, and *C. Diospyri ferruginea* Atkinson, are reduced to synonyms of *C. Diospyri* Thümen, the three names having been applied to different stages of growth of the same fungus.—J. C. A.

¹ American Naturalist 30: 529-536. 1896.

UNDER THE TITLE, "The suction-force of transpiring branches," S. H. Vines gives² a review of earlier experiments to show the means by which a current of water is maintained between the roots and the leaves of plants, and the results of some recent experiments to determine the suction-force of the leaf, which force has been suggested as the probable cause of sap elevation.—S. C. S.

SEPARATES have been distributed by Professor M. C. Potter,³ of Durham College, England, detailing the development and nature of the conidial stage of *Botrytis cinerea*. It appears to be a saprophyte, which grows less readily as a parasite, and is the initial cause of the rotting of stored turnips, etc. The conidia germinate readily in moist air, and infection takes place best through wounds or injury due to freezing. The fungus is more aggressive as a parasite after growing for a time saprophytically.—J. C. A.

KRAUS has studied at Buitenzorg⁴ the heat produced in flowers of cycads, palms, and arums. His measurements in the spadices of *Ceratozamia longifolia* and *Macrozamia Mackenzi* showed a daily period repeated for several days, with a mid-afternoon maximum, the maximum temperature excess being 11.7° C. Among the palms, *Bactris speciosa* showed a rise of temperature for several days, continuing through the night also. In the Araceæ a daily period with an evening maximum was observed, coincident with which was the intensity of odor.—C. R. B.

NESTLER has communicated to the Royal Academy of Sciences in Vienna the results of researches upon the excretion of liquid water by leaves.⁵ He finds that the special tissue often developed between the end of the tracheids and the water pore does not act as a secreting tissue, as has long been taught, but that the extrusion is due wholly to filtration under pressure. Many experiments show this; the following one may be cited as illustrative. If the excretion of water from young grass blades is checked by choking the water clefts or by killing the tips with hot water, the excretion appears in different places along the margin, probably through air pores.—C. R. B.

ITEMS OF TAXONOMIC INTEREST are as follows: F. V. Coville has published⁶ a new Ribes, *R. erythrocarpum*, from Crater Lake, Oregon, a region of the southern Cascades that seems never to have been explored botanically.

²Ann. Bot. 10:429-444. 1896.

³Rottenness of turnips and swedes in store. Reprinted from Jour. Bd. Agric. 3:—[1-14]. 4 plates.

⁴Physiologisches aus dem Tropen. III. Ueber Blütenwärme bei Cycadeen, Palmen, und Araceen, Annales du Jard. bot. de Buitenzorg 13²:217-275. pl. 3. 1896. Cf. Bot. Cent. 68:119. 1896.

⁵Esterr. bot. Zeits. 46:371. 1896.

⁶Proc. Biol. Soc. Washington 10:131-132. 1896.

The same author has published⁷ also a new rush from the Rocky mountain region, *Juncus confusus*, which has heretofore been confounded with *J. tenuis congestus* Engelm. In the same connection a synopsis of *J. tenuis* and its allies, seven species in all, is given. Professor E. L. Greene's last fascicle of "new or noteworthy species"⁸ contains descriptions of new species in the following genera: Cratægus, Mentzelia (2 sp.), Coleosanthus, Solidago (2 sp.), Chrysopsis, Grindelia (3 sp.), Aster, Arnica (4 sp.), and Senecio (4 sp.). Among the numerous new species which Mr. Hemsley has described⁹ from an interesting collection received from central Tibet is a new genus of grasses which he has named *Littledalea*.—J. M. C.

DR. W. ARNOLDI has obtained some interesting results from his study of Isoetes and Selaginella.¹⁰ The species used were *I. Malinverniana* and *S. cuspidata*, and their association under the title indicates the author's conclusion that Isoetes is to be regarded as a heterosporous lycopod. In the formation of the prothallium of Isoetes the macrospore nucleus passes to the apex of the spore and divides, the daughter nuclei again dividing. At this time the arrangement and staining of the striations of protoplasm about the nuclei indicate that cell walls are about to be formed. The spore wall becomes double and walls are formed about the nuclei, usually leaving the nucleus unenclosed on the side toward the center of the macrospore. The unenclosed nucleus divides, and the daughter nucleus nearest the periphery of the macrospore becomes enclosed by a wall. The free nucleus continues to divide in the same manner, one of the resulting nuclei constantly passing outward and toward the center of the macrospore, until all are enclosed. The enclosed nuclei near the apex of the spore continue dividing, and become separated by new walls. New cells are formed more rapidly along the periphery of the macrospore, but are more tardily extended toward the center. Cell formation is not usually completed in the basal and central parts of the macrospore when archegonia are fully formed at the apex.

The process in Selaginella is so similar to that in Isoetes that the same figures might easily serve to illustrate both. The nuclei divide and become enclosed in the same way, the prothallia are in about the same stage of development when the archegonia appear, and even the comparative size of cells in homologous portions of the prothallia is the same. In Selaginella no diaphragm appears separating the prothallium into vegetative and reproductive parts. In Isoetes the archegonia do not become green.

It becomes evident that the processes here observed are very similar to endosperm formation in the spermatophytes. Much more evidence upon

⁷ *Ibid.* 127-130.

⁹ Kew Bulletin 119:207-215. 1896.

⁸ Pittonia 3:99-106. 1896.

¹⁰ Die Entwicklung des weiblichen Vorkeimes bei den heterosporen Lycopodiaceen. Bot. Zeit. 9:159-168. 1896.

this point may be obtained when the early stages in the endosperm formation of gymnosperms has been more thoroughly worked out. It is to be regretted that Dr. Arnoldi did not extend his work into the embryogeny of the sporophyte. Additional evidence upon the suspensor formation in this group may help to answer the question concerning the supposed relationship of lycopods and gymnosperms.—O. W. C.

MR. J. H. HART discusses briefly¹¹ the so-called "irritability" of the flowers of *Catasetum tridentatum* Hook., of which Darwin gives an account in his *Fertilization of Orchids*. In opposition to Darwin's observations he says:

"The ejection of the pollinia can be caused by other means than the irritation of the antennæ by touch A concussion of the flower, the removal of the anther cap, and pressure exerted on almost any part of the column, and especially any irritation on the margins of the stigmatic pit will effect this readily if the flower is at a favorable stage of maturity.

" the expulsion of the pollen does not depend upon any special irritability, but upon *mechanical action alone*."

"The antennæ are seen to be merely a prolongation of the edges of the stigmatic pit A part of this curl holds the margin of the caudicle The antennæ at anthesis become turgid, stiff, and non-elastic. In this state they furnish levers which are amply sufficient to cause a disturbance of the grip they hold upon the margin of the caudicle."

The question needs further study. It is one which can only be satisfactorily examined in a tropical laboratory.—C. R. B.

A BRIEF SUMMARY of MacDougal's work on the mechanism of curvature of tendrils¹² is as follows: Those tendrils which are irritable to contact are of such great difference in morphological derivation, anatomy, and degree of irritability, that it is unsafe to assume their mechanism to be identical. The curvature of a tendril about a support as a direct reaction to irritation, and the coiling of a free portion, are entirely distinct and largely independent processes.

Curvature in the tendrils of Passifloreæ is due to the contraction of the tissues of the concave side, which theory is not in harmony with that of De Vries, viz., that increased osmotic activity of the convex side results in an accelerated growth extension of the tissues of the same side.

The structure of the protoplasm of the convex and concave sides is quite different, that of the concave side being more richly granular, and more nearly filling the cell cavity. The density of the protoplasm of the concave

¹¹ Bull. Misc. Inform. Roy. Bot. Gard. of Trinidad 2:225. 1896.

¹² Annals of Botany 10:373-402. 1896.

side increases from the base toward the tip, apparently corresponding with the degree of irritability to contact.

During curvature the parenchymatous cells of the concave side decrease in size from 20 to 40 per cent. of their original volume, and become irregularly globoid or ovoid; which is to be explained by an increase in the permeability of their protoplasts, with a consequent extrusion of water into the intercellular spaces, and a release of their stretching tension exerted upon their walls, the elastic contraction of which causes the resultant curvature.—W. R. M.

DR. EMIL KNOBLAUCH, the German translator of Warming's *Geographical Botany*, has published from Tübingen a paper upon the "Ecological anatomy of the woody plants of the South African evergreen bush-region." A review by Dr. E. Roth¹³ gives a brief summary of the results. The rainy winters and dry summers of the Cape Colony region result in a peculiar vegetation, in which dwarf shrubs dominate, both in species and individuals, trees being almost wholly absent. The woody plants are first treated, as, on account of their long duration, they show best the influence of external conditions upon vegetation, notably their adaptation to withstand drought. The anatomy of the leaves is especially considered, as they show most clearly these influences. The many evidences of a direct adaptation of the South African woody plants are enumerated as follows: (1) lignification; (2) evergreen habit; (3) dwarf growths, associated with thick branching, small branches, very short internodes and small leaves; (4) leaves more or less densely aggregated; (5) leaves more or less erect on the branches, thus avoiding direct rays of the sun at midday; (6) leaves with very small cross-section; (7) small leaf surface; (8) ericoid, pinoid, or involute leaves; (9) thick outer epidermal walls; (10) inner epidermal walls mucilaginous, swelling more or less when water is taken up; (11) epidermal cells of large capacity, allowing considerable water storage; (12) leaf symmetry dorsiventral and radial; (13) long palisade cells; (14) spongy mesophyll much less open than in mesophytes; (15) a brown coloring matter, probably tannin, present in the strongly illuminated peripheral portions of the leaves, forming a protection against too strong light; (16) presence of hairs on the furrowed side of ericoid leaves and of the dorsiventral involute leaves to protect against excessive transpiration. Any given species ordinarily has but few of the above characteristics, and all plants do not have them developed to the same degree. Another set of characters is not general, but is confined to certain groups of plants. These special characters are given as follows: (1) depression of stomata; (2) hypodermal aqueous tissue; (3) internal aqueous tissue; (4) sclerenchyma, which increases the rigidity of the aqueous and chlorophyll tissues; (5) oil reservoirs; (6) bud scales.—H. C. C.

¹³ Bot. Centralb. 67: 391. 1896.

F. DELPINO has just published¹⁴ a discussion upon the classification of monocotyledons, based upon certain new criteria. A review by Solla¹⁵ furnishes the basis for the following statement of his views. Engler's classification¹⁶ of 1892 has seemed to morphological taxonomists to be by far the most natural one yet proposed, and it remains to be seen whether Delpino has proposed anything better in the way of natural grouping. He recognizes the two monocotyledonous groups, the eucyclic (trimerous pentacyclic floral structure) and the polycyclic (unstable floral structure and varying number of whorls). The eucyclic monocotyls are not regarded as primitive, but as derived from the polycyclic groups, which are believed to be the "connecting link" between eucyclic monocotyls and dicotyls. In both the monocotyl groups there are forms which have retrograded, giving rise to four taxonomic groups, viz., normal and reduced polycyclic forms, and normal and abnormal eucyclic forms.

The group of "normal polycyclic monocotyls" includes Alismaceæ, Butomaceæ, and the higher genera of the Hydrocharideæ. The author makes the Butomaceæ his starting point, and considers *Butomus umbellatus* to be the oldest form, because it resembles several polycyclic dicotyls. Connected with these is the group of "reduced polycyclic monocotyls," which includes the lower Hydrocharideæ, Juncagineæ, Aponogetonaceæ, Potamogetonaceæ, and Naiadaceæ.

The "eucyclic monocotyls" include all the rest of the families with pentacyclic structure. The nectary furnishes a biological and phylogenetic character by which they are subdivided into three groups: the *Anadenien*, which have no nectaries; the *Carpadenien*, which have nectaries in connection with the carpels; and the *Petaladenien*, which have nectaries in connection with the floral leaves.

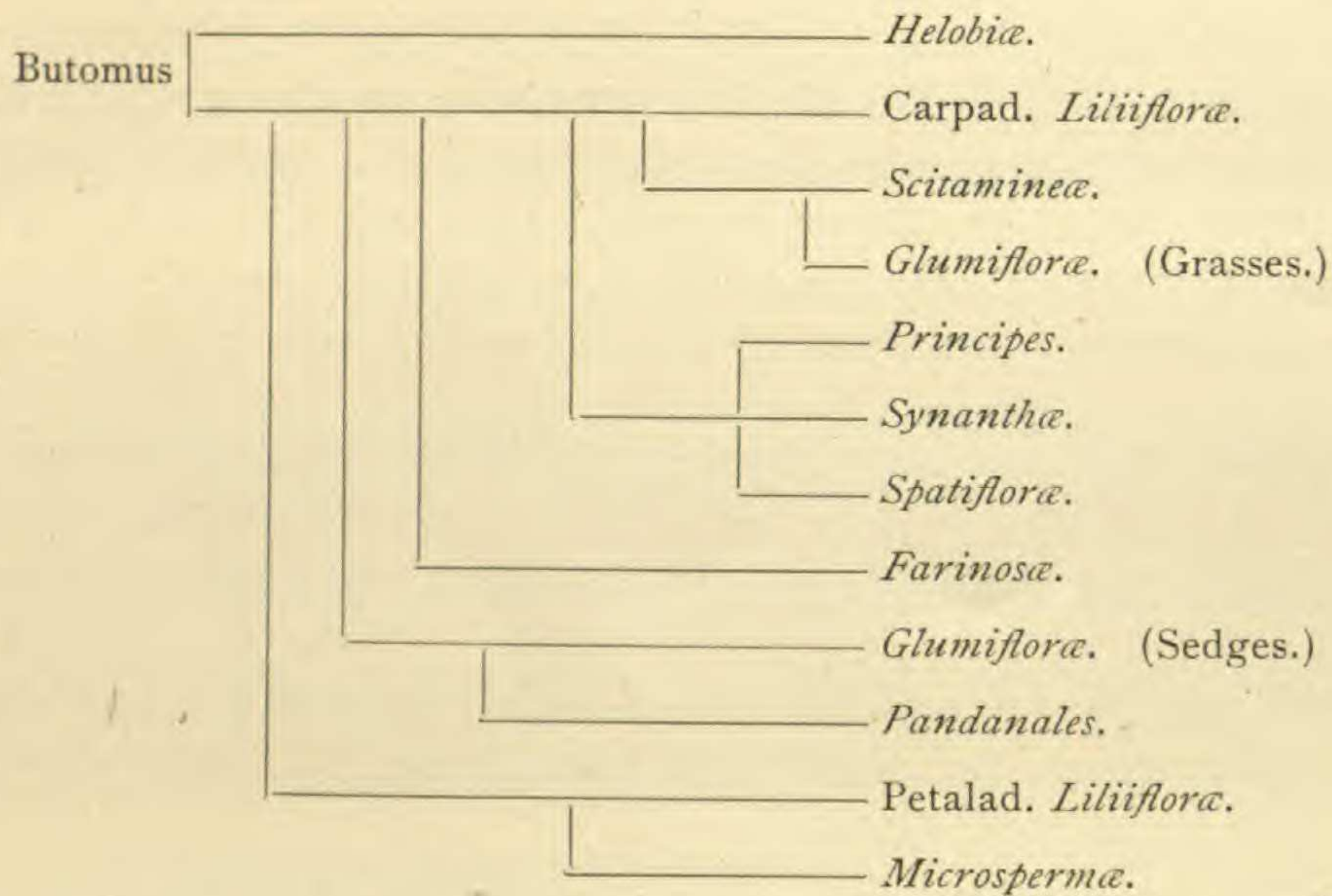
The author regards the leaves as of taxonomic value in large groupings. These groups are as follows: (1) those with sword-shaped leaves, subdivided into Gladiatæ and Hemigladiatæ; (2) those with three-sided leaves, all of which may be derived from the genus *Dracæna*; (3) those with ligules (Gramineæ, etc.)

It will be noted that Delpino, like Engler, makes two groups of monocotyls, but only the Helobiæ are regarded as polycyclic, all the rest being eucyclic. The author also regards monocotyls as monophyletic, while Engler's scheme makes them triphyletic. The following tabular statement presents Delpino's scheme, which certainly has the merit of being quite different from others.

¹⁴ Mem. Real. Accad. Sci. Bologna V. 6:83-116. 1896.

¹⁵ Bot. Centralb. 67:370. 1896.

¹⁶ Die systematische Anordnung der monokotyledoneen Angiospermen: Abhandl. König. Preuss. Akad. Wissen. Berlin, 1892.



—C. J. C.

ALTHOUGH THE EXISTENCE of acid secretions by roots has been known for nearly forty years, no exact knowledge of the chemical composition of these secretions was at hand. To fill this gap, and to reinvestigate the opinion of Molisch that diastatic and inverting enzymes are secreted by the root, Czapek undertook the investigations to which brief reference has already been made on p. 65 of this volume. In the full paper¹⁷ the excretions of roots are exhaustively discussed. A translation of the author's own summary is here given.

The roots of the higher plants, under culture either in a saturated atmosphere or in water, secrete a series of dissolved substances, partly inorganic, partly organic.

The droplets which are generally seen on root hairs in a saturated atmosphere are produced by filtration under pressure, and appear only when the hair cells are highly turgescient.

Of inorganic substances which roots give off in water may be named: potassium, calcium, magnesium, hydrochloric acid, sulfuric acid and phosphoric acid. Only potassium and phosphoric acid are present in any considerable quantity; they are found in the form of primary potassium phosphate, in many cases by far the predominant constituent of the residuum upon evaporating the root excretions.

The mono-potassium phosphate (KH_2PO_4) arises in all probability in great part from living cells of root hairs, the epidermis, and the outer cortex in the piliferous region.

Neither acetic acid nor lactic acid, as was asserted on many sides, is found in the root excretions. Formic acid, in the form of its potassium salt, is of not

¹⁷ Jahrbücher f. wiss. Botanik 29: 321-390. 1896.

uncommon occurrence. It diffuses from living cells in the youngest part of the root and is therefore not a product of destructive processes.

The detection of oxalic acid as primary potassium oxalate is at present limited to the excretions of the root of *Hyacinthus orientalis*.

The well known permanent reddening of litmus paper depends as a rule upon the acid reaction of mono-potassium phosphate. Its intensity varies, and these differences are parallel with the amount of phosphate excreted. The acid reaction of the hyacinth roots to litmus paper has, on the contrary, another source, which is referable to the primary oxalate.

If the phenomena of the corrosion of stone plates by roots are studied by using artificially prepared plates consisting of substances of known solubility in certain acids, it becomes evident that the carbonic acid excreted must play the principal rôle in all the etching observed. One may say in general that substances which cannot be dissolved by carbonic acid cannot be attacked to any extent by the root excretions, so that corrosive action does not appear. It is to be observed that we have to deal not with the action of carbonic acid in free gaseous condition, but with the solvent actions of fluid saturated with carbonic acid, as the water of imbibition of the outer layers of the membrane of the root cells and the adjacent films of the soil water. Moreover, all known phenomena of corrosion can be completely explained by the action of carbonic acid. Hence it results that the reddening of litmus and the corrosion of stones depend upon the action not of the same but of two different substances (mono-potassium phosphate and carbonic acid). No other free acid is secreted, normally at least, by roots. Acid action upon the substratum by substances secreted by roots, however, is probable from a series of empirically established facts, and it occurs, as a matter of fact, without relation to the effects produced by carbonic acid. The mono-potassium phosphate excreted by the roots takes a prominent part in bringing about this action, since it enters into reaction with neutral salts of the stronger acids and thus leads to the production of smaller amounts of the mineral acids concerned. Especially is this the case with the chlorides and the formation of hydrochloric acid. A condition for such acid action upon the substratum is that the dissociated neutral salt shall not be readily taken up and consumed by the plant, but may enter in more or less undiminished amount into reaction with the phosphate. Naturally the amounts of acids thus formed are very small, yet they are sufficient in a long period of time to produce noteworthy effects in large masses of soil thoroughly permeated by roots, by means of which its insoluble constituents are unlocked and made available to plants.

An excretion of diastatic or inverting enzymes by the roots is physiologically not inconceivable, but certainly does not occur normally. Critical repetition of the researches of Molisch, who has asserted a normal occurrence of these ferments in root secretions, shows instead a negative result when one carefully considers the sources of error.—C. R. B.

THE ANATOMY of the vascular plants has been treated from the standpoint of physiology by several writers, notably Schwendener and Haberlandt. The comparative anatomy of the lower plants has dwelt chiefly upon the reproductive processes. Istvánffi published in 1891 in Hungarian a short paper entitled "Contributions to the physiological anatomy of fungi,"¹⁸ and now offers a further contribution¹⁹ in which he pays particular attention to the conducting system in the Hydneæ, Thelephoreæ, and Tomentelleæ. Necessarily he deals chiefly with the fructifications.

Following the general plan of Schwendener and Haberlandt he classifies the false tissues of the fungi into four systems: (1) the merismatic, (2) the protective, (3) the nutritive, (4) the reproductive.

The tissues corresponding to the meristem of higher plants are very rarely differentiated. The tips of many rhizomorphs, as in *Armillaria mellea*, show an extraordinary resemblance to the tips of phanerogamous roots, which is heightened by the mucilaginous sheath, corresponding to the root cap. Besides these growing points may be enumerated the merismatic pycnidia, the margin of the pileus and similar growth zones.

The protective system is manifold. (1) To the epidermal system are to be referred the superficial tissues, whether formed of parallel hyphæ or of pseudo-parenchyma; the various scales and similar structures of the higher Hymenomycetes; the cortex, which may be as much as four-layered, as in *Lactarius resimus*; the colossal cortex of the woody *Polypori*; the paraphyses and cystidia which prevent the stripping of the spores and are often stiffened by mineralization; and the various thickenings about sporangia and spores. (2) The mechanical system includes all arrangements for maintaining bodily form. These are: in single celled species the elasticity of walls and turgor; in multicellular ones transverse walls; thickening of walls; the protective tissues, sometimes forming an outer skeleton; the rosette-like or cylindrical groups of bladder-like hyphæ as in the Agaricineæ; and the palisade-like grouping of the basidia.

The nutritive system includes (1) an absorptive system, (2) a conducting system, (3) a storage system, (4) an aerating system, and (5) an excretory and secretory system.

The absorptive tissues include the general mycelium when submerged, the haustoria and appressoria, and the various compound forms into which hyphæ are united (bands, cords, strands, or membranes), serving also a mechanical function.

The conducting system, to which Istvánffi has given chief attention by

¹⁸ Adatok a gombák physiologiai anatómiájához, Természetrájszi Füzetek 15: 52-67. *pl. 1.* 1891.

¹⁹ Untersuchungen über die physiologische Anatomie der Pilze mit besonderer Berücksichtigung des Leitungssystems bei den Hydnei, Thelephorei und Tomentellei, Jahrb. f. wiss. Botanik 29: 391-440. *pls. 5.* 1896.

detailed descriptions, includes the structures generally known as latex and oil reservoirs, and vascular hyphæ. These contain both plastic and by products of metabolism. They are emptied in connection with the formation of the fructification. The elements of the conducting system are short club shaped cells, or long thin tubes, or very long much branched and anastomosing tubes, all multinucleate. They arise as lateral outgrowths from the ordinary hyphæ and when mature have many connections with them. When the fructification is very young they form a dense coil in the center. In rhizomorphs and band like mycelia they appear in a similar way. There is no regularity in their distribution, but they usually form one or several layers at the margin of the stipe and beneath the hymenium.

Since the earlier researches of Istvánffi and Olsen, Van Bembke has examined fifty-three species of ten families and Istvánffi sixty species of the three families above named, both European and exotic. The extent of these researches justify a classification of the elements of the conducting system into six groups, the first five of which include the tubular reservoirs: (1) *Hymenochaete* type, undulate, with pointed ends protruding from the hymenium; (2) wholly internal (only in two species); (3) *Stereum* type, parallel with the surface, bending out into the hymenium, their ends not or scarcely swollen; (4) *Thelephora* type, vertical to the surface, often in several zones; (5) *Corticium* type, in several layers, the ends clubbed (*keulig aufgeschwollen*); (6) round reservoirs.

A considerable number of examples of each of these types are described in detail. Istvánffi thinks the character of the conducting system may be used systematically.

The storage system of tissues includes chiefly the sclerotia.

To the aerating system are referred the air spaces in the interior of the stipe and pileus, as in Agaricineæ and Phalloideæ, which increase in size toward the center.

The excretory and secretory system comprehends the structures excreting resin-like materials, reservoirs of coloring matters and poisons, a part of the cystidia (especially those with crystalline contents), and the glandular hairs upon the absorbing system of *Schizophyllum* spp.—C. R. B.